# APPENDIX H-4

# AIRCRAFT NOISE EMISSION ESTIMATES

## *APPENDIX H4: AIRCRAFT NOISE ESTIMATES*

This appendix provides a summary of expected 1-second maximum noise levels during flyover events by different types of aircraft and helicopters. The tabular data summary complements the flyover event noise level chart presented in the text of the EIS. In addition, this appendix presents the letter reports prepared by the Army summarizing noise data collected during evaluation of the Shadow 200 UAV.

The detailed spreadsheets documenting the noise calculations generally do not lend themselves to hard copy printing. Electronic versions of the spreadsheets can be made available on request.

## ESTIMATED 1-SECOND Lmax NOISE LEVELS FOR AIRCRAFT AND HELICOPTER FLYOVER EVENTS

| SLANT DISTANCE, FEET | ESTIMATED MAXIMUM 1-SECOND AVERAGE FLYOVER EVENT NOISE LEVEL (dBA) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | OH-58D 100 KNOTS | UH-60 100 KNOTS | CH-47D 100 KNOTS | CH-53D 100 KNOTS | CH-53E 100 KNOTS | AH-1G 100 KNOTS | AH-1W 100 KNOTS | C-130 180 KNOTS | C-17 230 KNOTS | SHADOW UAV |
| 50 | 97.2 | 98.8 | 104.3 | 105.0 | 106.7 | 103.2 | 106.2 | 105.9 | 110.0 | 102.2 |
| 100 | 91.0 | 92.7 | 98.2 | 98.9 | 100.6 | 97.0 | 100.0 | 99.5 | 103.4 | 96.0 |
| 125 | 88.9 | 90.7 | 96.2 | 96.9 | 98.6 | 94.9 | 97.9 | 97.4 | 101.3 | 94.1 |
| 160 | 86.9 | 88.7 | 94.1 | 94.8 | 96.5 | 92.9 | 95.9 | 95.2 | 99.1 | 91.9 |
| 200 | 84.8 | 86.6 | 92.1 | 92.8 | 94.5 | 90.8 | 93.8 | 93.1 | 96.8 | 89.9 |
| 250 | 82.7 | 84.5 | 90.1 | 90.7 | 92.4 | 88.8 | 91.8 | 90.9 | 94.5 | 87.9 |
| 315 | 80.6 | 82.4 | 88.0 | 88.7 | 90.4 | 86.7 | 89.7 | 88.7 | 92.1 | 85.8 |
| 400 | 78.5 | 80.3 | 86.0 | 86.6 | 88.3 | 84.6 | 87.6 | 86.4 | 89.6 | 83.5 |
| 500 | 76.3 | 78.2 | 83.9 | 84.4 | 86.1 | 82.5 | 85.5 | 84.0 | 87.0 | 81.4 |
| 630 | 74.1 | 76.0 | 81.8 | 82.3 | 84.0 | 80.4 | 83.4 | 81.7 | 84.3 | 79.2 |
| 800 | 71.9 | 73.8 | 79.8 | 80.1 | 81.8 | 78.2 | 81.2 | 79.2 | 81.4 | 76.9 |
| 1,000 | 69.6 | 71.5 | 77.6 | 77.9 | 79.6 | 76.0 | 79.0 | 76.7 | 78.4 | 74.6 |
| 1,250 | 67.3 | 69.2 | 75.5 | 75.6 | 77.3 | 73.8 | 76.8 | 74.2 | 75.2 | 72.3 |
| 1,600 | 64.9 | 66.8 | 73.3 | 73.3 | 75.0 | 71.5 | 74.5 | 71.5 | 71.9 | 69.5 |
| 2,000 | 62.5 | 64.4 | 71.1 | 70.9 | 72.6 | 69.1 | 72.1 | 68.9 | 68.4 | 66.9 |
| 2,500 | 59.9 | 61.9 | 68.8 | 68.5 | 70.2 | 66.7 | 69.7 | 66.1 | 64.8 | 64.2 |
| 3,150 | 57.3 | 59.2 | 66.5 | 65.9 | 67.6 | 64.1 | 67.1 | 63.4 | 61.2 | 61.1 |
| 4,000 | 54.7 | 56.5 | 64.1 | 63.3 | 65.0 | 61.5 | 64.5 | 60.6 | 57.6 | 57.6 |
| 5,000 | 51.9 | 53.6 | 61.7 | 60.5 | 62.2 | 58.7 | 61.7 | 57.8 | 54.0 | 54.0 |
| 6,300 | 49.0 | 50.5 | 59.1 | 57.6 | 59.3 | 55.8 | 58.8 | 54.9 | 50.4 | 49.8 |
| 8,000 | 46.0 | 47.3 | 56.5 | 54.6 | 56.3 | 52.8 | 55.8 | 51.9 | 46.8 | 44.9 |
| 10,000 | 42.9 | 43.9 | 53.7 | 51.4 | 53.1 | 49.6 | 52.6 | 48.9 | 43.1 | 39.6 |
| 12,500 | 39.6 | 40.3 | 50.8 | 48.0 | 49.7 | 46.2 | 49.2 | 45.7 | 39.4 | 33.5 |
| 16,000 | 36.2 | 36.5 | 47.7 | 44.4 | 46.1 | 42.6 | 45.6 | 42.5 | 35.6 | 25.5 |
| 20,000 | 32.7 | 32.4 | 44.4 | 40.5 | 42.2 | 38.9 | 41.9 | 39.0 | 31.7 | 16.8 |
| 25,000 | 29.0 | 28.0 | 40.9 | 36.3 | 38.0 | 34.9 | 37.9 | 35.3 | 27.7 | 6.5 |

Notes:

The U.S. Air Force OMEGA10R noise model estimates SEL and Lpk noise levels for aircraft flyover events, but a 1-second Lmax noise level is more representative of how people hear peak flyover event noise levels.

SEL and Lpk data from the OMEGA10R model were converted to estimated 1-second Lmax values by simulating the time history of the flyover event using the SEL data for the reference distance of 315 feet as a control value.

The flyover simulation model divides the flyover event into 25 time intervals, with the duration of each inteval dependent on aircraft flight speed and the assumed length of the audible flight track (2 nautical miles for both approach and departure segments).

The relatively low flight speed of helicopters required an adjustment to the maximum interval Leq value in order to estimate 1-second Lmax noise levels from the 5.3-second interval Leq values.

For helicopters, the simulated maximum interval Leq value from the time history simulation was increased by 3.5 dBA when the difference between the maximum simulated noise level and the OMEGA10R instantaneous Lpk value exceeded 5 dBA.

For fixed wing aircraft, no adjustments were made to the simulated maximum noise level at 315 feet since simulated interval durations were between 2 and 3 seconds.

Estimated Lmax values for distances other than 315 feet were scaled from the distance profile of Lpk values generated by the OMEGA10R model.

Estimated Lmax values for 50 feet based on drop-off rate for the 100 to 200 foot distance range.

Noise levels for the twin engine CH-53D helicopter estimated as 1.76 dBA lower than the data available for the three engine CH-53E model.

Noise levels for the twin engine AH-1W helicopter estimated as 3 dBA higher than the data available for the single engine AH-1G model.

The estimated Lmax values for the UAV were derived using a distance attenuation model applied to reported Lmax data for the UAV engine at a high power setting.

Source: Tetra Tech analyses.

**Sound Level Measurements on the Shadow Tactical Unmanned Aerial Vehicle: Fort Huachuca, AZ**
(provided via e-mail from Roger K. Baker, UAVS Project Office, Redstone Arsenal, to John Gallup)

1. The measurements were taken on 10 Jan 01, during the approximate time period of 1615 hours until 1730 hours. The test was conducted at Rugge Hamilton Airfield at Fort Huachuca, AZ. The temperature during this time period varied from 51 degrees F and 54 degrees F. The relative humidity varied from 49 to 53 percent. The average wind speed during this time period varied from 6 to 9 miles per hour, with gusts of up to 12 miles per hour.

2. The sound level measurements were obtained with a Bruel and Kjaer type 2209 sound level meter with a type 1613 octave filter set, which were calibrated on 22 Jun 00.

3. The sound level measurements obtained were the following:

a. The distance from the TUAV to the location where the sound level was 85 dB(A), 103 dB(A), and 108 dB(A), at 90 degree increments from the direction in which the TUAV was pointed. The location at which these sound levels occurred was determined with the TUAV engine at low RPM and also at high RPM. Due to the limited amount of test time allotted for this test (one hour and fifteeen minutes), the sound measurements were made at 90 degree increments around the TUAV, rather than the desired 45 degree increments. The sound level measurements were taken on a paved, level airstrip and the plane was repositioned at 90 degree increments in order to achieve the correct orientation between the TUAV and the sound measurement location.

b. At the operator position at a distance of 100 feet to the side of the TUAV (the operator controls are on a 100 foot cable), with the TUAV engine at low RPM, the decibel levels were measured at each of the octave freqency bands by use of the octave filter set on the sound level meter.

4. The following are the distances from the Shadow TUAV to the 85 dB(A) levels when the TUAV engine is at low RPMs.

| | |
|---|---|
| Distance from nose of TUAV | 62 ft 5 in |
| Distance from right wing of TUAV | 64 ft 9 in |
| Distance from tail of TUAV | 44 ft 8 in |
| Distance from left wing of TUAV | 76 ft 9 in |

5. The following are the distances from the Shadow TUAV to the 103 dB(A) levels when the TUAV engine is at low RPMs.

| | |
|---|---|
| Distance from the nose of TUAV | 5 ft |
| Distance from right wing of TUAV | 11 ft 3 in |
| Distance from tail of TUAV | 9 ft 4 in |
| Distance from left wing of TUAV | 11 ft 3 in |

6. The following are the distances from the Shadow TUAV to the 108 dB(A) levels when the TUAV engine is at low RPMs.

| | |
|---|---|
| Distance from right wing of TUAV | 8 ft |
| Distance from left wing of TUAV | 7 ft 6 in |

In the direction of the TUAV nose and tail, the location of the 108 dB(A) level is on top of the TUAV when the engine is at low RPM.

7. The following are the distances from the Shadow TUAV to the 85 dB(A) levels when the TUAV engine is at high RPMs.

| | |
|---|---|
| Distance from nose of TUAV | 276 ft |
| Distance from right wing of TUAV | 338 ft |
| Distance from tail of TUAV | 75 ft 2 in |
| Distance from left wing of TUAV | 346 ft |

8. The following are the distances from the Shadow TUAV to the 103 dB(A) levels when the TUAV engine is at high RPMs.

| | |
|---|---|
| Distance from nose of TUAV | 53 ft |
| Distance from right wing of TUAV | 64 ft 6 in |
| Distance from tail. of TUAV | 45 ft 3 in |
| Distance from left wing of TUAV | 62 ft 2 in |

9. The following are the distances from the Shadow TUAV to the 108 dB(A) levels when the TUAV engine is at high RPMs.

| | |
|---|---|
| Distance from nose of TUAV | 31 ft 7 in |
| Distance from right wing of TUAV | 42 ft 8 in |
| Distance from tail of TUAV | 23 ft 9 in |
| Distance from left wing of TUAV | 37 ft 9 in |

10. At the operator position, which is 100 feet to the side of the Shadow TUAV, the following are the dB levels measured at the octave frequency bands when the TUAV engine is at low RPMs. Also included is the linear (unweighted) dB level at this location under the same conditions. Most of the time that the Shadow TUAV operator is performing operations, the TUAV engine is at low RPMs.

| | |
|---|---|
| 31.5 hz | 77 dB |
| 63 hz | 73 dB |
| 125 hz | 78 dB |
| 250 hz | 85 dB |
| 500 hz | 84 dB |
| 1000 hz | 75 dB |
| 2000 hz | 68 dB |
| 4000 hz | 70 dB |
| 8000 hz | 72 dB |
| 16,000 hz | 65 dB |
| 31,500 hz | 52 dB |
| Linear dB | 89 dB |

**Sound Level Measurements on the Shadow Tactical Unmanned Aerial Vehicle: White Sands Missile Range, NM**
(provided via e-mail from Roger K. Baker, UAVS Project Office, Redstone Arsenal, to John Gallup)

1. Objective

To assess the noise levels from the Shadow TUAV engine and the Ground Control Station (GCS) generator.

2. Criteria

For steady state noise levels, the hearing protection requirements are established through the Health Hazard Assessment process. The following guidelines should be used for steady state noise levels:

a. Greater than or equal to 85 dB(A), but less than or equal to 103 dB(A), personnel must wear single protection.

b. Greater than 103 dB(A), but less than or equal to 108 dB(A), personnel must wear earplugs and noise muffs or noise attenuating helmets in combination (that is, double hearing protection). Exception: If the operation requires the Kevlar infantryman's helmet and compatible noise muffs are not available, personnel must wear earplugs and comply with the time limits for daily noise exposure in table 6-2

c. Greater than 108 dB(A), but less than or equal to 129 dB(A), personnel must wear double hearing protection and comply with the time limits on daily exposure in table 6-3. (Table 6-3 states that for dB(A) of 114 the time limit is 2 hours per day, for dB(A) of 117 the time limit is 1 hour per day, and for dB(A) of 120 the time limit is 30 minutes per day.)

d. Greater than 129 dB(A), TSG must approve exposure. (Department of the Army Pamphlet 40-501, para 6-2b.

3. Test Procedures

a. For the sound levels on the Shadow TUAV engine, measurements were taken on 20 August 2001 from 1120 until 1150 hours. The test was conducted at the helipad behind the Cox Range Control Building at White Sands Missile Range, NM. The temperature during this time was approximately 90 degrees F. The relative humidity was 28%. The wind direction was 150 degrees at 6.6 knots with a maximum of 14.8 knots.

b. For the sound levels on the GCS generators (an Isuzu 10 KVA model 3LD1 and a Honda 2.5 KVA model CB 2500x) and on the inside of the GCS, measurements were

taken on 10 October 2001 from 1030 to 1100 hours. The test was conducted at the helipad behind the Cox Range Control Building at White Sands Missile Range NM. The temperature during this time was approximately 71 degrees F. The relative humidity was 32%. The wind direction was 074 degrees at 4 – 7 knots.

c. The sound measurements were taken with a Simpson type 884-2 sound level meter which was calibrated on 4 Apr 01.

4. Test Findings

a. The sound level measurements obtained from the Shadow engine were the following:

1. The distance from the TUAV to the location where the sound level was 85 dB(A), 103 dB (A), and 108 dB(A), at 45-degree increments from the direction in which the TUAV was pointed. The location at which these sound levels occurred was determined with the TUAV engine at 6600 RPM. The tests were conducted on a dirt field with natural desert vegetation. There was one 380 HMMWV directly to the right of the Shadow. The distance from the Shadow to the HMMWV was approximately 64' (to the door of the vehicle). This is the deployment configuration of the Shadow.

| Direction | Distance to 108 dB(A) | Distance to 103 dB(A) | Distance to 85 dB(A) |
|---|---|---|---|
| South (Nose) | 12' 5" | 22' | 106' 10" |
| Southwest (45 degrees between right wing and nose) | 16' 5" | 23' 5" | 123' 6" |
| West (right wing) | 25' 10" | 40' 4" | 163' 10" |
| Northwest (45 degrees between right wing and tail) | 5' 10" | 10' 10" | 197' 5" |
| North (tail) | inside box | 6' 2" | 84' 6" |
| Northeast (45 degrees between tail and left wing) | 27' 6" | 41' | 204' 2" |
| East ( left wing) | 21' 5" | 36' 11" | 174' 6" |
| Southeast (45 degrees between left wing and nose) | 17' 7" | 26' 9" | 139' 10" |

2. Measurements were also taken from the start up position of the crew chiefs and the operator position which is 75 feet from the side of the TUAV. The operator controls are on a 75-foot cable. The following are the measurements taken from the crew chiefs and operators positions.

| | |
|---|---|
| Left crew chief | 120 dB(A) |
| Right crew chief | 116 dB(A) |
| Operator | 94 dB(A) |

b. The sound level measurements at crewman occupied locations inside the GCS with the Isuzu generator on and all fans on were 75 dB(A), with the door open or shut. The sound level measurements were obtained at the ear level height of seated and standing crewmen.

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c. The sound level measurements of the Isuzu generator taken in three places instead of the usual eight. The generator is in a tunnel between the back of the vehicle cab and the front of the shelter on the curbside and the three places were at 45-degree increments to the right of the generator. Three feet to the right front of the generator the sound measurement was 85 dB(A). Five feet directly in front of the generator on the curbside of the vehicle the sound measurement was 85 dB(A). Two feet two inches to the right rear of the generator the sound measurement was 85 dB(A).

d. The sound level measurements of the Honda generator were taken by a person standing next to the generator, holding the sound level meter at approximately ear level. The sound levels were 75 dB(A) in any position.

5. Technical Analysis

According to the criteria guidelines, the following level of hearing protection is required:

a. No hearing protection is required inside the GCS or around the Honda generator.

b. Single ear protection would be required of the operator and also within five feet of the Isuzu generator.

c. The Right crew chief would be limited to one hour with double hearing protection.

d. The left crew chief would be limited to 30 minutes with double hearing protection.

e. Personnel within twenty eight feet of the TUAV would require double hearing protection and would have to limit the time spent within that circle in accordance with table 6-3 of DA PAM 40-501. Personnel within forty-one feet but no closer than twenty-eight feet would require double hearing protection. Personnel within two hundred and four feet but no closer than forty-one feet would require single hearing protection.

DEPARTMENT OF THE ARMY
U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
5158 BLACKHAWK ROAD
ABERDEEN PROVING GROUND, MARYLAND 21010-5403

REPLY TO ATTENTION OF

MCHB-TS-OHH (40-10) 11 January 2002

MEMORANDUM THRU U.S. Army Materiel Command (AMCSG-H~~X~~ RJ 24 Jan 02 LTC Robert Wallace), 5001 Eisenhower Avenue, Alexandria, VA 22333-0001

FOR U.S. Army Aviation and Missile Command (AMSAM-MMC/ Mr. Harold Allen), Redstone Arsenal, AL 35898-5000

SUBJECT: Updated Health Hazard Assessment Report on the Shadow 200, Tactical Unmanned Aerial Vehicle (TUAV), Block I, Project No. 69-37-7732-02

1. References.

a. Memorandum, USACHPPM, MCHB-TS-OHH, 18 Dec 00, subject: Initial Health Hazard Assessment Report (IHHAR) on the Shadow 200, Tactical Unmanned Aerial Vehicle (TUAV), Block 1, Project No. 69-37-7732-01.

b. Memorandum, Electronic Proving Ground, CSTE-DTC-WS-EP-SE, Ft. Huachuca, AZ, 26 Nov 01, subject: Update to Limited Safety Release Recommendation for the Shadow 200 Tactical Unmanned Aerial Vehicle (TUAV) Block I.

c. DA PAM 40-501, 10 Dec 98, Hearing Conservation Program.

2. As requested, we have completed an updated Health Hazard Assessment Report (HHAR) on the Shadow 200, Tactical Unmanned Aerial Vehicle (TUAV), Block 1, Project No. 69-37-7732-02. This memorandum will serve as the updated HHAR.

a. The initial HHAR, reference 1a, identified the need for steady-state noise data for a complete assessment of the system. That noise data is provided in reference 1b.

Use of trademarked names does not imply endorsement by the U.S. Army but is intended only to assist in identification of a specific product.

This updated HHAR is provided to you on behalf of the Office of The Surgeon General (OTSG) since the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) is designated as the Executive Agent for the Army's HHA Program.

b. Incorporate the steady-state noise hazard and associated recommendations into MANPRINT and System Safety Issue/Hazard Tracking Logs. Please provide us with a copy of your program's documented risk mitigation and management decisions associated with the steady-state noise hazard addressed in this updated HHAR (e.g., Safety and Health Data Sheet, Programmatic Environmental Safety and Occupational Health Evaluation, Human Systems Integration Report, or other appropriate documents).

3. The Shadow 200, Block 1, TUAV provides reconnaissance, surveillance, and target acquisition to U.S. Army brigades and regiments at an initial range of 50 km, day or night, in limited adverse weather conditions. It is intended for use in environments where real-time information is needed, but manned aircraft are unavailable, or excessive risk or other conditions render use of manned aircraft imprudent. A more detailed system description is provided in reference 1a.

4. Identification of Health Hazard Issue. Steady-state noise.

5. Assessment of Health Hazard Issue. Steady-state noise.

a. Medical criteria and health effects. Health effects and criteria associated with steady-state noise are presented in Appendix A.

b. Health hazard assessment.

(1) Potential sources of high steady-state noise for the TUAV, addressed in this updated HHAR, are the Shadow 200 Air Vehicle engine and ground control station (GCS) generators.

(2) Steady-state noise data on the Shadow 200 Air Vehicle were measured at the helipad behind the Cox Range Control Building at White Sands Missile Range, NM. The engine was operating at 6600 RPM (reference 1b). Octave band data were not measured.

(a) The data documented the steady-state noise contours indicated below (figures are provided in Appendix B):

85 dBA contour - 61.9 meters (204.2 feet) (see Figure 1)
103 dBA contour - 12.5 m (41.0 ft.) (see Figure 2)
108 dBA contour - 8.4 m (27.5 ft.) (see Figure 3)
Contour overview (see Figure 4)

(b) Data for the TUAV crewmember positions are:

Left crew chief - 120 dBA
Right crew chief - 116 dBA
Operator's position (75 ft. from TUAV) - 94 dBA

(3) Shadow 200 Air Vehicle crew chief/operator positions.

(a) Data collected at the crew chief locations documented a worst case of 120 dBA. The DA PAM 40-501 hearing conservation requirement states that personnel must wear double hearing protective devices (HPDs) and comply with the time limits on daily exposures >108 dBA but $\leq$129 dBA (see Table below). Exception: The 108 dBA time-weighted average (TWA) limit may be increased if indicated through the calculation of

TABLE: Daily Steady-State Noise Exposure Limits When Double Hearing Protection is Worn (reference 1c)

| dBA | Time Limit Per Day (24 hours) |
|---|---|
| 111 | 4 hours |
| 114 | 2 hours |
| 117 | 1 hour |
| 120 | 30 minutes |
| 123 | 15 minutes |
| 126 | 7.5 minutes |
| 129 | 3.75 minutes |

the effectiveness of the specific hearing protector and the particular noise environment (reference 1c). This exception requires octave band noise data at the locations of interest.

(b) If 30 minutes per 24 hours is too restrictive (see Table above), obtain steady-state noise data at the crew chief's locations for the Shadow 200 Air Vehicle as follows: Provide steady-state noise data using "slow" meter response for both overall A-weighted levels and individual un-weighted octave band levels from 63 Hz to 8 kHz for a more in-depth analysis. This may show that double hearing protection is adequate for TUAV ground operations.

(4) The GCS generators.

(a) The steady-state noise levels for the GCS crewman occupied locations, with the tunnel generator (®Isuzu 10 kVA model 3LD1) operating and all GCS fans on, were 75 dBA with the door open or closed. No HPDs are required.

(b) The 85 dBA contour for the Isuzu 10 kVA GCS tunnel generator is 1.5 m (5 ft). Personnel within this noise contour must wear Army approved HPDs.

(c) Data for the ®Honda 2.5 kVA model CB 2500x support generator documented a steady-state noise level of 75 dBA at all operator positions. No HPDs are required.

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®Isuzu is a registered trademark/tradename of American Isuzu Motors Inc., Engine Operations, Novi, MI.

®Honda is a registered trademark/tradename of American Honda Motor Co., Honda Power Equipment Group, Alpharetta, GA.

6. Recommendations. Steady-state noise.

a. Shadow 200 Air Vehicle. A risk assessment code (RAC) of 2 [Hazard Severity (HS) II, Hazard Probability (HP) C] is assigned for failure to comply. A residual RAC of 4 (HS II, HP E) is assigned if recommendation 6a(2) is adopted. The residual RAC would likely be reduced further if engineering controls were adopted.

(1) Define and implement engineering noise control measures on the Shadow 200 Air Vehicle, if feasible.

(2) Include the following requirements in the TUAV technical and training manuals:

(a) Crew chief's location. Require all personnel at the crew chief's location (worst-case, 120 dBA) to wear Army-approved double HPDs (e.g., approved earplugs in combination with a noise-attenuating helmet or noise muffs) and comply with a time limit of 30 minutes exposure per 24 hours during operations.

(b) 85 dBA contour. Require all personnel to wear an Army-approved HPD when within 62 m (204 ft.) of an operating Shadow 200 Air Vehicle.

(c) 103 dBA contour. Require all personnel to wear Army-approved double HPDs when within 13 m (42 ft.) of an operating Shadow 200 Air Vehicle.

(d) 108 dBA contour. Require all personnel to wear Army-approved double HPDs when within 9 m (29 ft.) of an operating Shadow 200 Air Vehicle and limit exposure time per the above Table [paragraph 5b(3)(a)].

b. The GCS generators. A RAC of 2 (HS II, HP C) is assigned for failure to comply. A residual RAC of 4 (HS II, HP E) is assigned if the following recommendation is adopted.

(1) Occupied GCS crew positions. No recommendation is necessary.

(2) Isuzu 10 kVA tunnel generator. Require all personnel within the 85 dBA contour of 1.5 m (5 ft.) of an operating onboard generator to wear Army-approved HPDs.

(3) Honda 2.5 kVA model CB 2500x support generator. No recommendation is necessary.

7. The Army's HHA Program provides you with information to minimize health risks to soldiers, compensation claims, and lost time resulting in improved soldier performance, training and readiness. The enclosure includes an estimate of medical costs avoided by taxpayers as a result of your program's implementation of our recommendations contained in his HHAR. The annual costs include one soldier injured and 5 lost workdays for a total annual medical cost avoided of over $11,000. This is a 20-year estimated cost avoided of over $225,000. These conservative estimates are based upon the purchase of 44 TUAV systems.

8. Direct inquiries regarding this updated HHAR to the HHA Program's point of contact (POC), Mr. Robert Gross, at DSN 584-2925 or COM 410-436-2925. The contributing program within USACHPPM is the Army's Hearing Conservation Program (Mr. Bill Corbin) at DSN 584-3797 or COM 410-436-3797. Please complete and return the electronic version of USACHPPM Form 323.

MCHB-TS-OHH
SUBJECT: Updated Health Hazard Assessment Report on the Shadow 200, Tactical Unmanned Aerial Vehicle (TUAV), Block I, Project No. 69-37-7732-02

FOR THE COMMANDER:

Encl

Carl G. Hover
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Program Manager
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CF:
HQDA, ODCSPER
CDR, PERSCOM
CDR, MEDCOM
CDR, TRADOC
CDR, FORSCOM
COMDT, AMEDDC&S
DIR, ARL-HRED

# APPENDIX A

## Health Effects and Criteria

1. Steady-state noise.

a. A steady-state noise level of 85 dBA or greater is considered hazardous (references A-1 and A-2). This limit assumes no more than 8 hours per day of exposure to high noise levels. For exposure exceeding 8 hours per day, noise levels below 85 dBA are potentially hazardous (reference A-2). Prolonged unprotected exposure to hazardous noise levels will cause loss of hearing.

b. Design limits. Use MIL-STD-1474D, Requirement 1, Table 1-1, Category D, (Steady-state Noise, Personnel Occupied Areas, 85 dBA) as the design limit noise level for the TUAV shelters if future modifications are required. Collect steady-state noise associated with the operation and maintenance of the TUAV in accordance with Requirement 1 (Steady-state Noise, Personnel Occupied Areas), MIL-STD-1474D (reference A-3) for an updated HHAR.

2. Hearing protection devices (HPDs).

a. All personnel exposed to hazardous noise must wear HPDs. The DA PAM 40-501 (reference A-2) lists HPDs approved for Army use.

b. Proper HPDs are fitted for size by properly trained personnel (if preformed earplugs or helmets), adequately maintained, and properly inserted/adjusted or worn by the wearer.

c. Double hearing protection consists of Army approved earplugs in combination with a noise-attenuating helmet or noise muffs.

## References

A-1. AR 40-5, 15 Oct 90, Preventive Medicine.

A-2. DA PAM 40-501, 10 Dec 98, Hearing Conservation Program.

A-3. MIL-STD-1474D, Department of Defense Design Criteria Standard, Noise Limits, with NOTICE 1: 29 Aug 97.

**Shadow 200 Air Vehicle 103 dBA Contour**

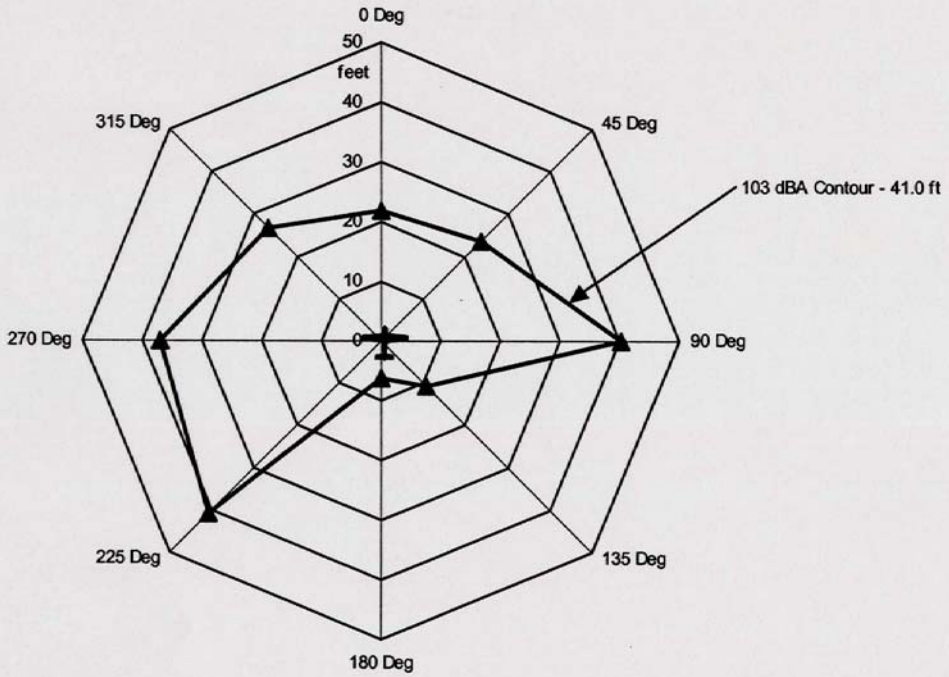


FIG. 2

JECT: Updated Health Hazard Assessment Report on the Shadow 200, Tactical Unmanned Aerial
.cle (TUAV), Block I, Project No. 69-37-7732-02

**Shadow 200 Air Vehicle 108 dBA Contour**

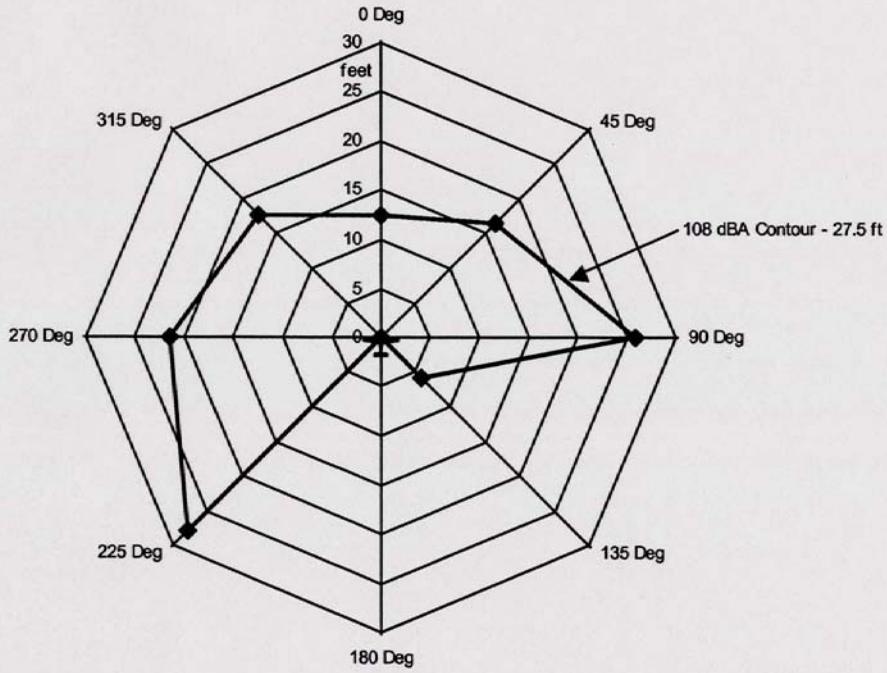


FIG. 3

JECT: Updated Health Hazard Assessment Report on the Shadow 200, Tactical Unmanned Aerial
cle (TUAV), Block I, Project No. 69-37-7732-02

**Shadow 200 Air Vehicle Steady-state Noise Contours**

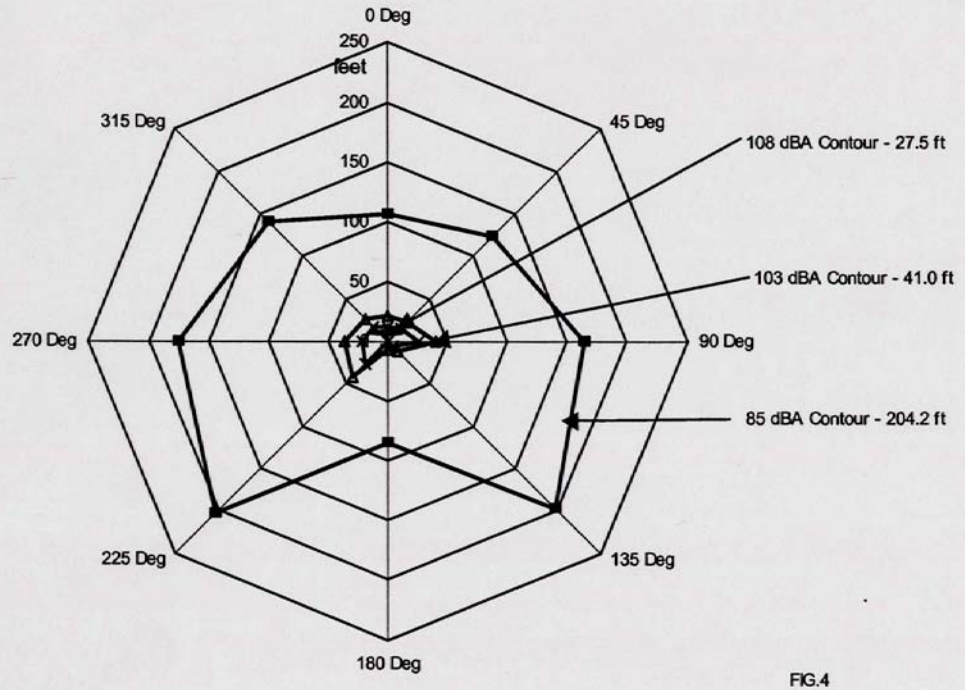


FIG.4

# *HHA Office Cost Avoidance Breakdown Report*

*08-Jan-02*

**Project No:** 7732
**No Systems:** 44 **No People:** 22 **System Risk** LOW

**PROJECT TOTAL**

| | CURRENT | RESIDUAL | AVOIDED |
|---|---|---|---|
| No. persons exposed: | 387 | 2 | 385 |
| No. persons injured/ill: | 3 | 0 | 3 |
| No. persons lost time: | 1 | 0 | 1 |
| No. persons hospitalized: | 0 | 0 | 0 |
| No. persons disabled | 0 | 0 | 0 |
| No. persons require rehab | 0 | 0 | 0 |
| No. clinic vists: | 37 | 0 | 37 |
| No. lost days: | 11 | 0 | 10 |
| No. hospital days: | 0 | 0 | 0 |
| No. deaths: | 0 | 0 | 0 |
| Cost of clinic visits: | $4,492 | $22 | $4,470 |
| Cost of lost time: | $800 | $4 | $796 |
| Cost of hospitalization: | $191 | $1 | $190 |
| Cost of disability: | $5,839 | $29 | $5,809 |
| Cost of rehabilitation: | $0 | $0 | $0 |
| Cost of deaths: | $0 | $0 | $0 |
| Total project cost 1 yr: | $11,322 | $57 | **$11,266** |
| Total project cost 20 yrs: | $226,442 | $1,132 | **$225,310** |

# *HHA Office Cost Avoidance Breakdown Report*

*08-Jan-02*

**Project No:** 7732
**No Systems:** 44 **No People:** 22 **System Risk** LOW

**Hazard Type: Steady state noise**

**Description:** Shadow 200 Air Vehicle

| | CURRENT | RESIDUAL | AVOIDED |
|---|---|---|---|
| **Risk Code:** | 2C, 2 | 2E, 4 | |
| **No. persons exposed:** | 194 | 1 | 193 |
| **No. persons injured/ill:** | 1 | 0 | 1 |
| **No. persons lost time:** | 1 | 0 | 1 |
| **No. persons hospitalized:** | 0 | 0 | 0 |
| **No. persons disabled** | 0 | 0 | 0 |
| **No. persons require rehab** | 0 | 0 | 0 |
| **No. clinic visits:** | 18 | 0 | 18 |
| **No. lost days:** | 5 | 0 | 5 |
| **No. hospital days:** | 0 | 0 | 0 |
| **No. deaths:** | 0 | 0 | 0 |
| **Cost of clinic visits:** | $2,246 | $11 | $2,235 |
| **Cost of lost time:** | $400 | $2 | $398 |
| **Cost of hospitalization:** | $96 | $0 | $95 |
| **Cost of disability:** | $2,919 | $15 | $2,905 |
| **Cost of rehabilitation:** | $0 | $0 | $0 |
| **Cost of deaths:** | $0 | $0 | $0 |
| **Total Hazard Cost 1 Yr:** | $5,661 | $28 | **$5,633** |
| **Total Hazard Cost 20 Yrs:** | $113,221 | $566 | **$112,655** |

**Hazard Type: Steady state noise**

**Description:** GCS generator (Isuzu 10 kVA, model# 3LD1, tunnel generator)

| | CURRENT | RESIDUAL | AVOIDED |
|---|---|---|---|
| **Risk Code:** | 2C, 2 | 2E, 4 | |
| **No. persons exposed:** | 194 | 1 | 193 |
| **No. persons injured/ill:** | 1 | 0 | 1 |
| **No. persons lost time:** | 1 | 0 | 1 |
| **No. persons hospitalized:** | 0 | 0 | 0 |
| **No. persons disabled** | 0 | 0 | 0 |
| **No. persons require rehab** | 0 | 0 | 0 |
| **No. clinic visits:** | 18 | 0 | 18 |
| **No. lost days:** | 5 | 0 | 5 |
| **No. hospital days:** | 0 | 0 | 0 |
| **No. deaths:** | 0 | 0 | 0 |
| **Cost of clinic visits:** | $2,246 | $11 | $2,235 |
| **Cost of lost time:** | $400 | $2 | $398 |
| **Cost of hospitalization:** | $96 | $0 | $95 |
| **Cost of disability:** | $2,919 | $15 | $2,905 |
| **Cost of rehabilitation:** | $0 | $0 | $0 |
| **Cost of deaths:** | $0 | $0 | $0 |
| **Total Hazard Cost 1 Yr:** | $5,661 | $28 | **$5,633** |
| **Total Hazard Cost 20 Yrs:** | $113,221 | $566 | **$112,655** |